Stratified Meta-Analysis to Examine Data Biases in Lung Cancer Studies of Refinery Workers

Sherman Selix
Yale University, sherman.selix@yale.edu

Follow this and additional works at: http://elischolar.library.yale.edu/dayofdata

Part of the Applied Statistics Commons, Biostatistics Commons, Categorical Data Analysis Commons, Design of Experiments and Sample Surveys Commons, Environmental Public Health Commons, Epidemiology Commons, Medical Biomathematics and Biometrics Commons, Medical Toxicology Commons, Occupational Health and Industrial Hygiene Commons, and the Vital and Health Statistics Commons

http://elischolar.library.yale.edu/dayofdata/2014/Posters/4

This Event is brought to you for free and open access by EliScholar – A Digital Platform for Scholarly Publishing at Yale. It has been accepted for inclusion in Yale Day of Data by an authorized administrator of EliScholar – A Digital Platform for Scholarly Publishing at Yale. For more information, please contact elischolar@yale.edu.
Stratified Meta-Analysis to Examine Data Biases in Lung Cancer Studies of Refinery Workers

Shae Selix, Rebecca Ward
Yale School of Public Health, Cardno ChemRisk LLC

The Issue
- Do refinery workers, particularly maintenance workers, have increased lung cancer risk from asbestos exposure?
- Previous researchers have looked at one refinery at a time, employed differing methodologies
- To isolate lung cancer risk, researchers have relied on different "unexposed" comparisons
- This has led to very heterogeneous data

Looking for a "signal in the noise"

The Data
- Query four scientific databases
- Systematically evaluate abstracts to find most recent, independent values
- Extract confidence intervals on risk in addition to 13 potential stratifying factors
- Combined database of over 200,000 workers

Meta-Analysis
- Weight each study estimate by the inverse of its variance, its "precision"
- Employ a "random effects model", assuming each estimate comes from a normal distribution
- Calculate Meta-Risk estimate, as shown below

\[
\hat{\theta}_{meta} = \frac{\sum_{i=1}^{N} w_i \hat{\theta}_i}{\sum_{i=1}^{N} w_i} = \frac{1}{SE^2 + \tau^2} \times \tau^2 = \frac{Q - df}{C}
\]

Calculations for meta-relative risk, assuming random effects. Cochrane Review

Population Controls

<table>
<thead>
<tr>
<th>Risk Ratio</th>
<th>IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meta-RR: 0.85 (0.71-1.01)</td>
<td></td>
</tr>
</tbody>
</table>

Refinery work protective of lung cancer
Potential Bias: “Healthy Worker Effect”, underestimates risk

Internal Controls

<table>
<thead>
<tr>
<th>Risk Ratio</th>
<th>IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meta-RR: 1.58 (1.27-1.98)</td>
<td></td>
</tr>
</tbody>
</table>

Refinery work associated with lung cancer
Potential Bias: differing smoking rates, overestimates risk

Discussion
- Risk of lung cancer in maintenance workers depends entirely on choice of “unexposed” population, which differ from refinery workers in confounding and opposite ways
- Association remains inconclusive, with implications for policy and litigation
- Meta-analytic methods and digitalization of literature allows for study of large populations
- By applying meta-analysis to an original database of varying research on a subject, key considerations of study design can be evaluated